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matical teachers last year resulted in the appointment of a very strong committee to inquire into the matter. The report of this committee and the discussion upon it amply justified Professor Perry's action. Both professor and schoolmaster came forward to advocate reforms in secondary schools suggested in the report; definite constructive proposals have been made as to the curriculum and conduct of examinations; and, though it is obvious that reform cannot stop at this stage, a valuable step in the right direction has been taken. 'The Teaching of English,' which the great public schools, accepting the traditional classical curriculum, have seriously neglected, received considerable attention. Mr. P. J. Hartog, in an able paper, drew attention to the method of teaching style in composition adopted in the principal French schools, and urged that the classical master is wrong in assuming that the only method of teaching English composition and style must be through the medium of Greek and Latin, of which languages the average school boy has not obtained a real grasp. The training of teachers is, undoubtedly, the problem of paramount importance in educational affairs to-day, and the debate on this subject was valuable in directing attention to the shortcomings of existing arrangements for training. Miss Walter's plea for a secondary school career for the future teachers of primary schools is one admitted by every one dealing with primary schools.

#### SCIENTIFIC BOOKS.

##### EHRlich's SEITENKETTENTHEORIE.

THE recently published work of Professor Aschoff (Ehrlich's 'Seitenkettentheorie und ihre Anwendung auf die Künstlichen Immunisierungsprozesse') will be of great use to those who desire to keep abreast with the progress of science in this fruitful field of investigation. It is, indeed, an intelligent review of the whole subject of acquired im-

munity, and includes a statement of the principal facts which have been developed by experiment, as well as a discussion of the various theories which have been advanced in explanation of these facts. The great interest attached to the subject and the extent of the field of investigation which has been developed since the epoch-making discovery of the antitoxins of diphtheria and of tetanus by Behring and Kitasato (1890) are shown by the extent of the literature given by Aschoff at the close of his review ('Zusammenfassende Darstellung'). This covers 41 pages and includes nearly 900 titles. Of these Ehrlich has contributed no less than 22. His first paper, published in 1891, demonstrated the remarkable fact that animals can be made immune against certain vegetable poisons (ricin and abrin), and that the blood serum of such animals contains an antitoxin which has a specific action in neutralizing the toxic effects of these poisons, when injected into non-immune and susceptible animals. In prosecuting his investigations Ehrlich has had the advantage over many others who have devoted themselves to similar researches in the fact that he is a most accomplished chemist, and has given special attention to that difficult branch of organic chemistry which is concerned with bodies of the class to which the antitoxins belong.

"In a paper published in 1897 Ehrlich advanced his 'side-chain' theory. He considers the individual cells of the body to be analogous, in a certain sense, to complex organic substances, and that they consist essentially of a central nucleus to which secondary atom-groups having distinct physiological functions are attached by 'side chains'—such as chemists represent in their attempts to illustrate the reactions which occur in the building up or pulling down of complex organic substances. The cell-equilibrium is supposed to be disturbed by injury to any of its physiological atom-groups—as by a toxin—and this disturbance results in an effort at compensatory repair during which plastic material in excess of the amount required is generated and finds its way into the blood. This Ehrlich regards as the antitoxin, which

is capable of neutralizing the particular toxin to which it owes its origin, if this is subsequently introduced into the blood. In this theory a specific combining relation is assumed to exist between various toxic substances and the secondary atom-groups of certain cellular elements of the body. The atom-groups which, in accordance with this theory, combine with the toxin of any particular disease germ, Ehrlich calls the 'toxicophoric side chain.'<sup>\*</sup>

The fact that the toxin produced by the tetanus bacillus has an elective affinity for the cells of the nervous tissues seems to be well established. The wonderful toxic potency of this toxin is shown by the researches of Kitasato and by those of Brieger and Cohn (1893). According to the last-named authors the chemical reactions of the purified toxin show that it is not a true albuminous body. When injected beneath the skin of a mouse weighing fifteen grams, in the dose of 0.00000005 gram, it caused its death, and one-fifth of this amount gave rise to tetanic symptoms. The lethal dose for a man weighing seventy kilograms is estimated by Brieger and Cohn to be 0.00023 gram (0.23 milligram). Comparing this with the most deadly vegetable alkaloids known, it is nearly six hundred times as potent as atropin and one hundred and fifty times as potent as strychnin. Ehrlich's explanation of the origin of antitoxins is opposed by Buchner and others. According to Buchner the antitoxins are to be regarded not as reactive products developed in the body of the immune animal, but as modified, changed and '*entgiftete*' products of the specific bacterial cells. He insists that they do not neutralize toxins by direct contact, but only through the medium of the living organism.

On the other hand, Ehrlich insists that the antitoxin neutralizes the toxin directly, in a chemical way, and that such neutralization occurs when they are mixed in a test-tube, even more effectually than when they are injected separately into the body of a suscep-

tible animal. The experimental evidence appears to me to be in favor of Ehrlich's view, but neither time nor space will permit me to present this evidence or to review the experimental data upon which Ehrlich bases his side-chain theory. The reader is referred to Professor Aschoff's work for a full discussion of the subject. Certainly Ehrlich's views are entitled to great consideration, but it is evident that his theory, however plausible it may appear, especially to chemists, is far from being established upon a reliable experimental basis. For us, the numerous facts which have been brought to light by his painstaking researches have a far greater scientific value than his '*Seitenkettentheorie*.'

GEO. M. STERNBERG.

#### DISCUSSION AND CORRESPONDENCE.

SOME MATTERS OF FACT OVERLOOKED BY PROFESSOR WILSON.

PROFESSOR WILSON seems to think that the general scientific public is in danger of getting 'a wrong impression' of the situation at Wood's Holl from my article in SCIENCE of October 3; and in order to prevent this he offers some criticisms and insinuations which, I think, may produce a worse impression than the one he desires to correct. Let me say, therefore, to begin with, that our different standpoints and opinions have been, and will doubtless continue to be held on perfectly friendly terms.

Professor Wilson has favored merging the laboratory in the Carnegie Institution, and he has insisted very strongly that the independence of the laboratory would not be thereby endangered in any essential respect. This view was naturally seductive, for what friend of the laboratory would not welcome a permanent support which could be had without the sacrifice of a single principle or condition of vital importance? The financial difficulties under which we have so long labored predisposed all to accept relief and forget the risk. The assurance that there was no real risk from the one who had carried on most of the negotiations for our side, and the conditions proposed by the Carnegie committee all tended to allay doubt. Our organization was to remain essentially as

<sup>\*</sup> Quoted from the writer's 'Text-book of Bacteriology,' second edition, 1891.